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Monitoring Agricultural Land Use over the Canadian Prairies Using AWiFS A Pilot Study

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Canada

Presentation Outline

- Agriculture in Canada
- Crop mapping using remote sensing
- Research up to date
- Future anticipation
- Acknowledgement

Agriculture in Canada

- **Total population 33 million people**
- **700,000 km² farmland**
- **5 acres of farmland per person**
- **provides 1 in 8 jobs and accounts for 8% of Canada's GDP**
- **5th largest exporter of agriculture products**
- **accounts for about 20% of the total world exports of wheat and wheat flour (10 year average)**



Requirement for Agriculture Land Use Information

- **Annual information on agriculture land use would permit more efficient and effective delivery of agricultural programs and policies**
- **Land use map is needed for deriving agriculture indicators used in modelling**
- **Also needed for risk management, un-seeded acreage, hail damage**
- **To monitor environmental threats due to surface runoff of fertilizer, herbicide and pesticide for the safety of the population**
- **Annual crop inventory system is needed**



EO-Based Crop Inventory

- **Earth Observation (EO) data can provide a key source of information for producing annual crop inventories**
- **For operational mapping, need to find a method that works consistently over different sites across Canada and repeatable over multiple years**
- **AAFC is required to deliver information on agriculture land use on an annual basis**

Pilot Studies for Method Testing (2004-2007)

- A four-year multi-sensor study was carried out by AAFC over five pilot sites across Canada
- Results demonstrated that multi-temporal satellite data can successfully classify crops for a variety of cropping systems
- Overall accuracies of 85% were achieved, and most major crops (corn, wheat and soybean) were also classified to this level of accuracy
- Results have been comparable through multiple years and cross multiple sites



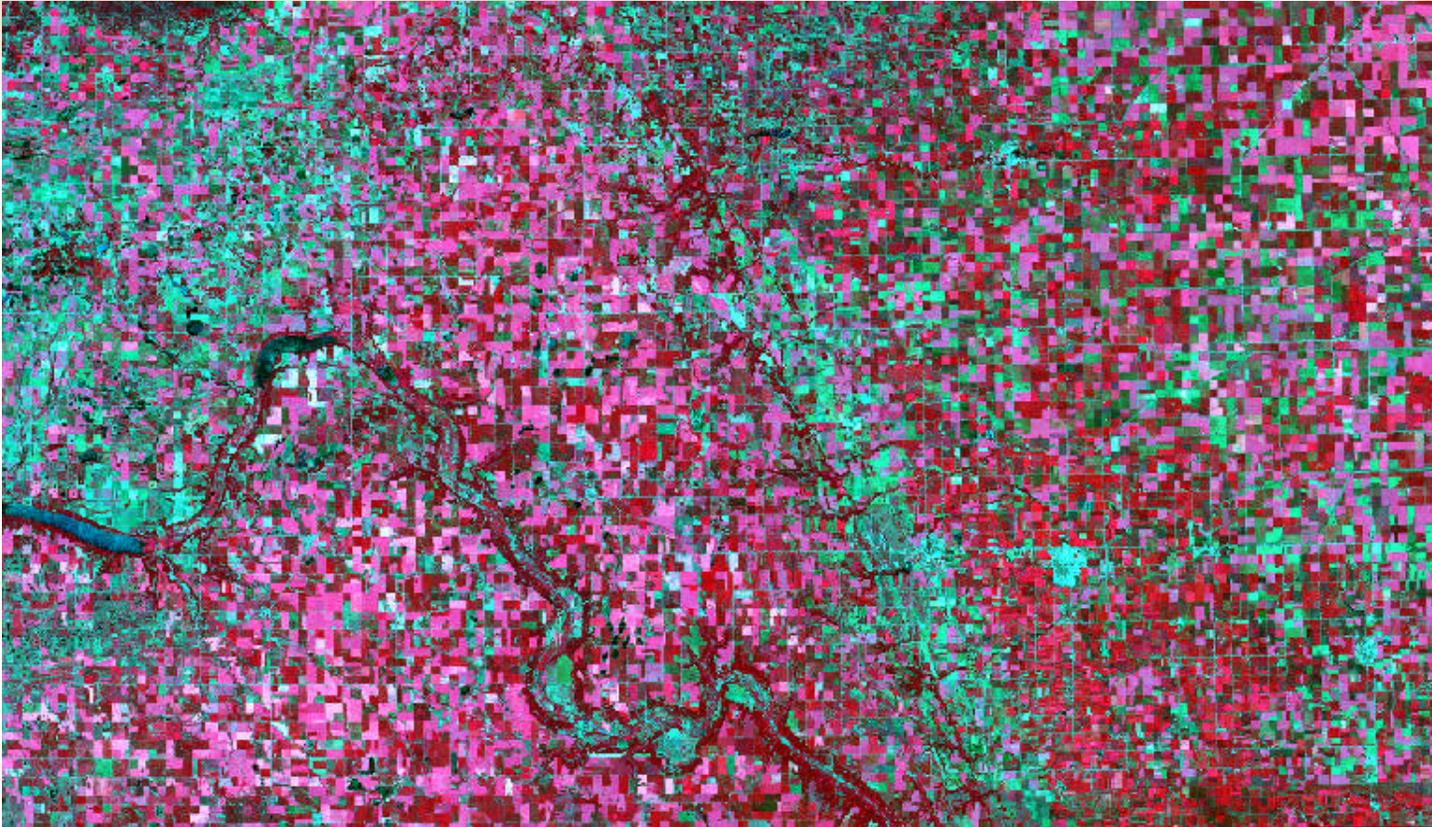
Challenge

- **When available, multi-temporal optical data are ideal for crop classification**
- **Timing of these acquisitions is critical. Optical data acquired later in the growing season has been found to provide the best overall classification accuracy, but this presents two challenges to operational crop mapping:**
 - *Late season optical data may not be available due to cloud cover*
 - *Dependency on late season imagery prevents the crop identification (and potentially acreage estimation) at an earlier point in the growing season*
- **To circumvent these problems, two approaches were adopted:**
 - *The addition of radar data will supplement the absence of later-season optical data*
 - *Integration of multi-frequency SAR (C- and L-band) will provide richer information content which could lead to successful crop identification earlier in the season*

Opportunities from AWiFS

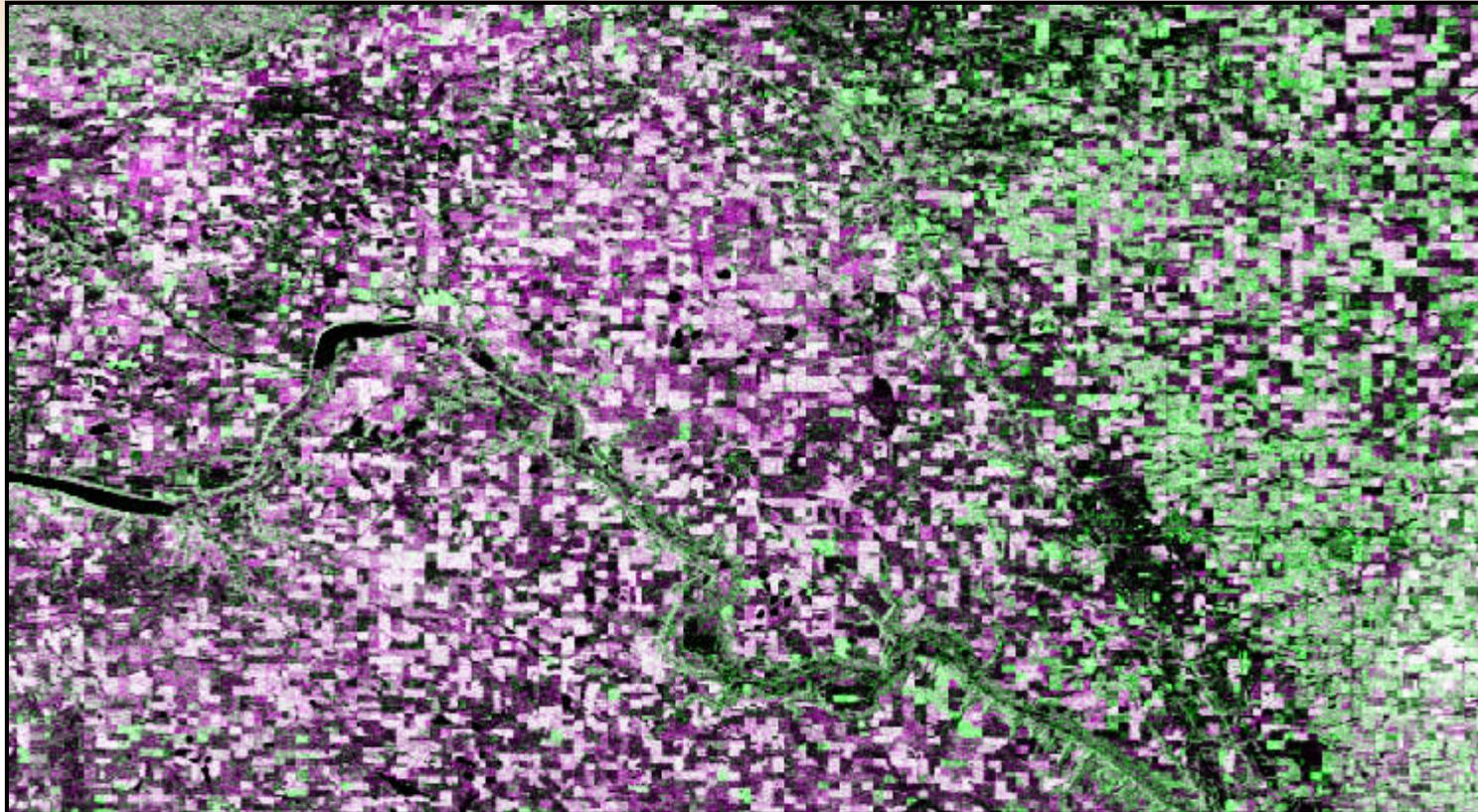
- **More frequent repeat coverage**
 - *Cloud cover becomes less of an issue*
- **Large footprint**
 - *Swath coverage and spatial resolution are comparable with RADARSAT-2 ScanSAR*
 - *Make national-scale crop inventory more feasible*

2008 AWiFS Pilot Study over southern Manitoba



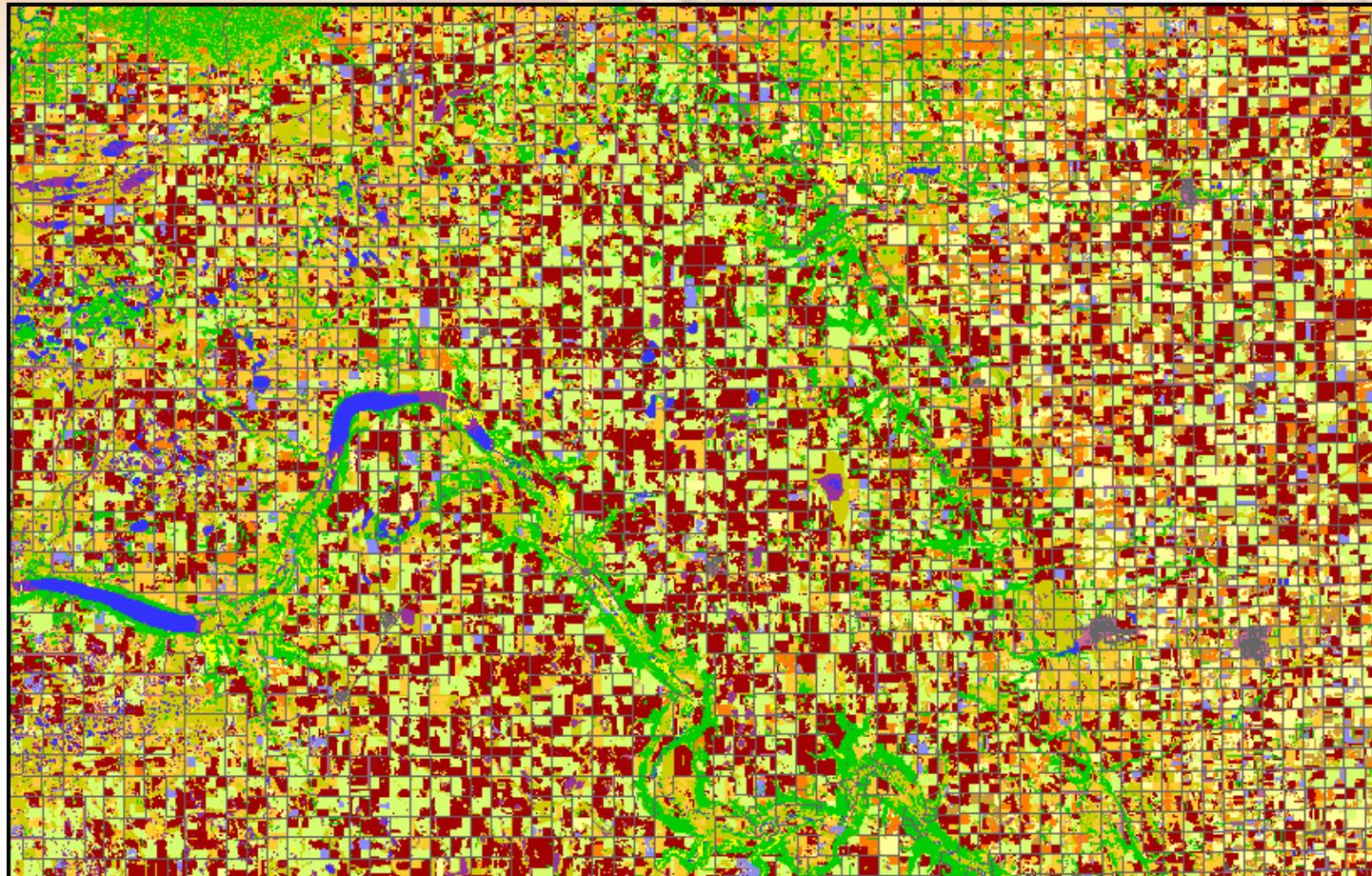
August 1 AWiFS: **Band 3** **Band 2** **Band 1**

2008 AWiFS Pilot Study over southern Manitoba



July 31 RADARSAT2 ScanSAR Narrow: **VV** **VH** **VV**

2008 Land use map of southern Manitoba



Legend

- Water
- Barren
- Urban
- Shrub land
- Wetland
- Hay-Pasture
- Soybean
- Corn
- Cereal
- Flax seed
- Forest
- Road Network

Derived using 6 dates of AWiFS data (Jun 19, July 9, Aug 1, Aug 6, Aug 20, Aug 30)

Classification Accuracy Comparison

Classification Accuracies Derived from Using Various Data Combinations
Southern Manitoba, 2008 Growing Season

ID	Combinations	AWiFS	RSAT2	Pasture	Flax	Conola	Sunflower	Corn	Soybean	Cereal	Overall	Kappa
1	6 AWiFS	Jun 19, Jul 9, Aug 1, Aug 6, Aug 20, Aug		90.2	92.2	88.6	90.1	47.8	71.8	91.1	86.3	0.83
2	3 early AWiFS	Jun 19, Jul 9, Aug 1		86.2	98.8	28.3	89.6	36.1	56.0	87.8	78.9	0.73
3	3 early AWiFS & 1 RSAT2	Jun 19, Jul 9, Aug 1	Jul 31	87.0	98.2	53.3	77.9	45.7	57.6	87.6	80.4	0.75
4	2 early AWiFS	Jun 19, Jul 9		64.6	79.5	40.4	56.8	8.1	52.4	84.4	66.7	0.57
5	2 early AWiFS & 1 RSAT2	Jun 19, Jul 9	Jul 31	76.2	91.3	48.4	56.9	48.6	56.2	85.0	74.3	0.67
6	1 late AWiFS	Aug 1		82.6	97.7	11.4	90.7	28.4	37.8	93.7	77.3	0.71
7	1 late AWiFS & 1 RSAT2	Aug 1	Jul 31	85.5	94.9	57.1	90.4	29.7	48.0	92.0	80.9	0.76

Conclusions

- Multi-temporal AWiFS data can produce an adequate crop classification over the Canadian prairies
- The addition of radar data can help improving classification accuracies, especially during the earlier season

Next Steps

Provide early-season estimate:

- EO Data
 - Multi-frequency radar data will be incorporated
 - Multi-angle radar SAR will be acquired to help crop identification at the early season
- Ground Data
 - Gain additional ground data from the provinces and crop insurance

Acknowledgements

- Field Data Collection
 - AAFC Prairie Farm Rehabilitation Administration
- AWiFS Data
 - Global Marketing Insight
 - USDA Foreign Agriculture Service



Thank You

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